

Customer No.: 31561
Docket No.: 10958-US-PA
Application No.: 10/604,651

In The Claims:

1. (currently amended) A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:
 - forming an amorphous silicon layer over a substrate;
 - performing a plasma treatment to the amorphous silicon layer, wherein the plasma treatment is selected from nitrous oxide (N₂O) plasma, ammonia (NH₃) plasma or hydrogen (H₂) plasma, and there is no film layer formed on the surface of the amorphous silicon layer after the plasma treatment is performed;
 - transforming the amorphous silicon layer into a polysilicon layer;
 - patterning the polysilicon layer to form a plurality of island polysilicon layers;
 - forming a channel region and a doped source/drain region on each side of the channel region in each island polysilicon layer; and
 - forming a gate over each channel region, wherein the channel region composed of polysilicon has an adjusted threshold voltage determined from determined by the plasma treatment.
2. (previously presented) The method of claim 1, wherein the plasma treatment is nitrous oxide (N₂O) plasma, and the threshold voltage of the channel region is adjusted in the negative direction.

Claim 3. (canceled)

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4. (previously presented) The method of claim 1, wherein the plasma treatment is ammonia (NH₃) plasma or hydrogen (H₂) plasma, and the threshold voltage of the channel region is adjusted in the positive direction.

Claims 5-6. (canceled)

7. (original) The method of claim 1, wherein the desired shift in the threshold voltage is effected by varying the radio frequency power to the plasma treatment.

8. (original) The method of claim 1, wherein the desired shift in the threshold voltage is effected by varying the processing period of the plasma treatment.

9. (original) The method of claim 1, wherein the step of patterning the polysilicon layer further comprises forming a gate insulation layer over the island polysilicon layers.

10. (currently amended) A method of forming a low temperature polysilicon thin film transistor, comprising the steps of:

providing a substrate;

forming an amorphous silicon layer over the substrate;

performing a plasma treatment to the amorphous silicon layer, wherein the plasma treatment is selected from nitrous oxide (N₂O) plasma, ammonia (NH₃) plasma or hydrogen (H₂) plasma, and there is no film layer formed on the surface of the amorphous silicon layer after the plasma treatment is performed;

performing a laser annealing process to transform the amorphous silicon layer into a polysilicon layer;

patterning the polysilicon layer to form a plurality of island polysilicon layers;

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forming a gate insulation layer over the island polysilicon layers;
forming a channel region in each island polysilicon layer and a doped source/drain region on each side to the channel regions; and
forming a gate over the channel regions, wherein the channel region composed of polysilicon has an adjusted threshold voltage ~~determining from~~ determined from the plasma treatment.

11. (previously presented) The method of claim 10, wherein the plasma treatment is nitrous oxide (N₂O) plasma, and the threshold voltage of the channel region is adjusted in the negative direction.

Claim 12. (canceled)

13. (previously presented) The method of claim 10, wherein the plasma treatment is ammonia (NH₃) plasma or hydrogen (H₂) plasma, and the threshold voltage of the channel region is adjusted in the positive direction.

Claims 14-15. (canceled)

16. (original) The method of claim 10, wherein the desired shift in the threshold voltage is effected by varying the radio frequency power to the plasma treatment.

17. (original) The method of claim 10, wherein the desired shift in the threshold voltage is effected by varying the processing period of the plasma treatment.

18. (original) The method of claim 10, wherein the laser annealing process comprises performing an excimer laser annealing process.

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19. (original) The method of claim 10, wherein the step of forming the amorphous silicon layer over the substrate, further comprises:

forming a silicon nitride layer over the substrate; and
forming a silicon oxide layer over the silicon nitride layer.

20. (original) The method of claim 10, wherein the step of forming a channel layer in each island polysilicon layer and a doped source/drain region on each side to the channel region further comprises:

forming a first patterned photoresist layer over the gate insulation layer to expose the upper surface of on each side of each island polysilicon layer; and
performing a p⁺ doping process.

21. (original) The method of claim 20, wherein the step of performing the p⁺ doping process further comprises removing the first patterned photoresist layer.

22. (original) The method of claim 10, wherein the step of forming a channel region in each island polysilicon layer and a doped source/drain region on each side to the channel region further comprises:

forming a second patterned photoresist layer over the substrate to cover a portion of the various island polysilicon layers and expose the upper surface on each side of the island polysilicon layers; and

performing an n⁺ doping process.

23. (original) The method of claim 22, wherein the step of performing the n⁺ doping process further comprises removing the second patterned photoresist layer.

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24. (original) The method of claim 23, wherein the step of removing the second patterned photoresist layer further comprises:

forming a third patterned photoresist layer over the gate insulation layer to expose an area adjacent to the doped source/drain region of various island polysilicon layer; and

performing an n⁻ doping process to form lightly doped drain regions.

25. (original) The method of claim 24, wherein the step of performing the n⁻ doping process further comprises removing the third patterned photoresist layer.

26. (original) The method of claim 10, wherein the step of forming a gate over the channel regions further comprises performing an activation process.

27. (original) The method of claim 10, wherein the step of forming a gate over the channel regions further comprises:

forming an inter-layer dielectric over the substrate;

forming a plurality of first openings in the inter-layer dielectric and the gate insulation layer to expose the doped source/drain regions; and

forming a plurality of source/drain metallic contacts over the inter-layer dielectric so that the source/drain metallic contacts and various doped source/drain regions are electrically connected via the first openings.

28. (original) The method of claim 27, wherein the step of forming a plurality of source/drain metallic contacts further comprises:

forming a passivation layer over the substrate;

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forming a second opening in the passivation layer to expose a portion of the source/drain metallic contact; and

forming a pixel electrode over the passivation layer such that the pixel electrode and a portion of the source/drain metallic contact are electrically connected through the second opening.

Claims 29-41 (canceled)

42. (new) A method of forming a low temperature polysilicon thin film transistor, comprising:

forming an amorphous silicon layer over a substrate;
performing a plasma treatment to the amorphous silicon layer, wherein the plasma treatment is selected from nitrous oxide (N₂O) plasma, ammonia (NH₃) plasma or hydrogen (H₂) plasma;

performing a laser annealing process so as to transform the amorphous silicon layer into a polysilicon layer, wherein the beam of the laser annealing process directly emits into the amorphous layer;

patternning the polysilicon layer to form a plurality of island polysilicon layers;
forming a channel region and a doped source/drain region on each side of the channel region in each island polysilicon layer; and

forming a gate over each channel region, wherein the channel region composed of polysilicon has an adjusted threshold voltage determined by the plasma treatment.

43. (new) The method of claim 42, wherein the plasma treatment is nitrous oxide (N₂O) plasma, and the threshold voltage of the channel region is adjusted in the negative direction.

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44. (new) The method of claim 42, wherein the plasma treatment is ammonia (NH₃) plasma or hydrogen (H₂) plasma, and the threshold voltage of the channel region is adjusted in the positive direction.

45. (new) The method of claim 42, wherein the desired shift in the threshold voltage is effected by varying the radio frequency power to the plasma treatment.

46. (new) The method of claim 42, wherein the desired shift in the threshold voltage is effected by varying the processing period of the plasma treatment.